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Technical Note for Adjusting Storage Ring Inter-station Phase

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Gross power imbalance between the two Storage Ring RF stations driving sector pairs is undesirable since it puts an unnecessary excessive power demand on one system. Generally the two RF stations are set up in a balanced state before beam is stored using the Gap Voltage AGC set points and it varies only slightly at 100 mA of stored beam due to beam loading.

In the event that the power imbalance is considered excessive ($>50\text{kW}$), the inter-station phase must be adjusted to compensate for this power imbalance. Usually this is done by the MCR crew on duty, but may be done by RF Group personnel if needed. This can be done with stored beam but special care has to be taken in adjusting the inter station phase without causing unintentional beam loss in the Storage Ring.

Keep in mind that the Storage RF systems may have intentionally been set-up un-balanced for other reasons: coupler heating or vacuum problems, etc., using the Gap Voltage AGC set points. In these cases adjusting inter-station phase is NOT the method of balancing them.

Each Storage Ring RF station has a phase shifter 1-0, fixed phase adjust which is available in *RF Panel* under *LLRF* (see *Figure 1*) and *SRRFPhaseSliders* on *OAGapps* (see *Figure 2*). This phase shifter is outside the phase control loops (before them) and has the ability to shift RF station phase relative to the RF Source and therefore is also relative to the other RF station. The phase shift range is two hundred degrees each.

These phase shifters are the ones used to make the inter stations phase adjustment. The control room has a “*comfort screen*” that automatically assembles the necessary software in EPICS along with the vector voltmeter screen from RF Source called “*Ph Det S38/S40 to S36/S37 Cav Phase*”, which is the measurement device. The phase read back has software tied to it that changes the color of the digits on-screen from green to red when pre-determined limits have been exceeded. These limits are changed from run-to-run and are not the absolute correct setting. It is the balancing of systems which is used (along with other variables related to the beam) that determines how far to adjust the phase shifters.

The two phase shifters also need to be adjusted in equal amounts in opposite directions to maintain Booster to Storage Ring Phase so as not to disturb the timing between them. You may choose a direction at random and *move the phase shifters 0.1 degree at a time* in opposite directions and observe the two stations klystron forward powers to determine if the power balance between them is improving (you are looking for a reduced differential power between them). Continue moving the phase shift slider in the same direction or go the opposite direction until the desired forward power difference is reached.



Figure 1. Storage Ring RF Stations Klystron Phase Shifter screens on *rfpanel*.

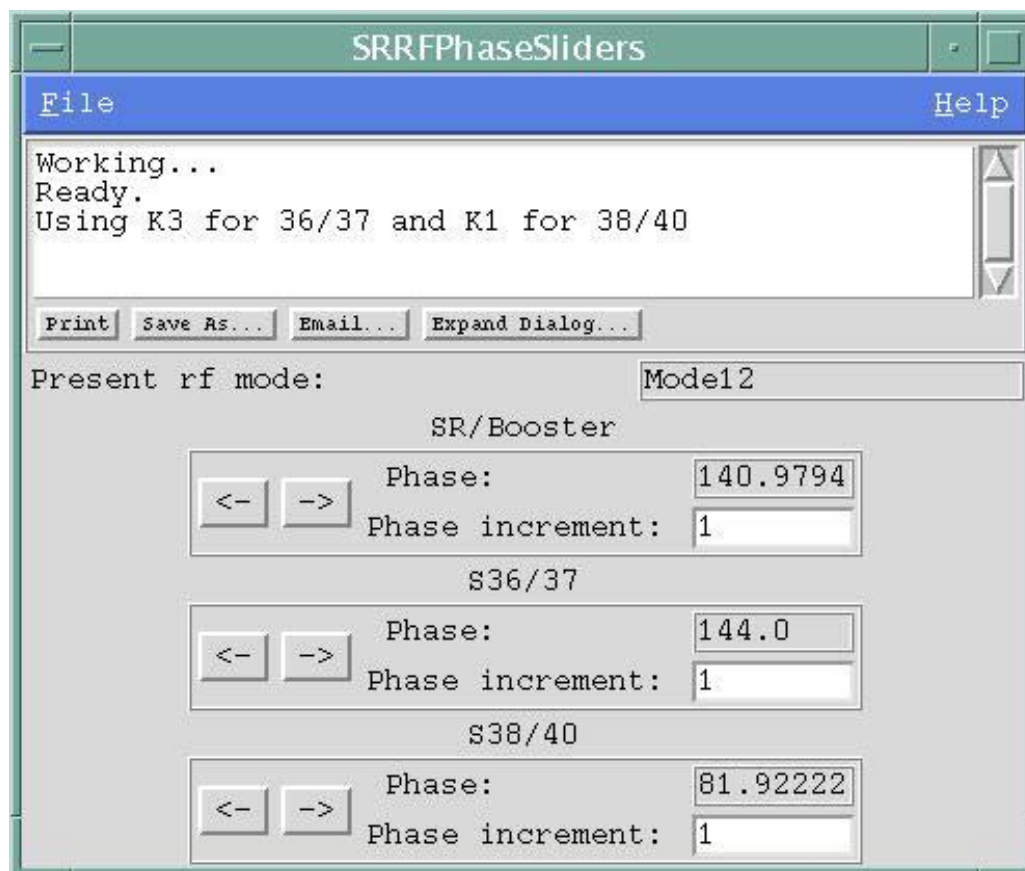


Figure 2. SR/Booster and SR RF Stations Phase Adjustment screen on *OAGapps*.